

27. The method of claim 26, wherein the barrier layer, etch stop, and anti-reflective coating each comprises silicon carbide material having a dielectric constant less than 7.0.
28. The method of claim 26, wherein the substrate has an effective dielectric constant of no greater than about 5.
29. The method of claim 26, further comprising removing a contaminant on the substrate by:
- a) introducing a reducing agent comprising nitrogen and hydrogen into a chamber;
 - b) initiating a reducing plasma in the chamber;
 - c) exposing an oxide on the substrate to the reducing agent.
30. The method of claim 24, further comprising filling the damascene structure with a liner layer and a conductive material to form a damascene feature.
31. The method of claim 30, further comprising depositing a silicon carbide barrier layer over the damascene feature.

REMARKS

This is intended as a full and complete response to the Office Action dated December 18, 2001, having a shortened statutory period for response set to expire on March 18, 2002. Claims 14-29 are pending in the application. Claims 14-29 were considered and are rejected by the Examiner. Applicants believe that no new matter has been introduced in this response.

Claims 14-29 stand rejected under 35 U.S.C. § 103(a) as obvious over the combination of *Endo et al.* (US Patent No. 4532150), European Patent 0725440, *Wang et al.* (US Patent No. 4872947), and Applicants' admitted prior art. The Examiner

asserts that it would have been obvious to one of ordinary skill in the art at the time the invention was made to employ the silicon carbide deposition process of *Endo et al.* or European Patent 0725440 as the dielectric or barrier layers in the Applicants' prior art structure; and form the silicon carbide layers *in situ* with other materials in view of the deposition processes in the disclosure of *Wang et al.* Applicants respectfully traverse this rejection.

Endo et al. discloses deposition of silicon carbide material on a metal substrate surface. European Patent 0725440 discloses depositing a silicon carbon barrier layer on a metal surface. *Wang et al.* discloses a thermal CVD deposition of silicon oxide followed by a plasma enhanced CVD deposition of silicon oxide in the same processing chamber. Applicants disclose knowledge of the use of anti-reflective coatings (ARC) and photoresist materials in photolithographic processes for patterning a feature shape on a substrate surface and then etching the feature shape to form a feature definition. Applicants disclose knowledge that prior art anti-reflective coatings (ARC) have had high dielectric constants.

↗ *Endo et al.* provides no disclosure or suggestion of silicon carbide as a barrier layer, etch stop, or ARC, or depositing a silicon carbide layer with a low dielectric constant. *Endo et al.* further provides no disclosure or suggestion of depositing a first dielectric layer *in situ* on a silicon carbide layer or depositing a photoresist layer. Applicants also disclose that *Endo et al.* provides no disclosure of SiC as a barrier layer, etch stop, or ARC.

↗ European Patent 0725440 does not disclose silicon carbide as an etch stop or anti-reflective coating as recited in one or more of the rejected claims. As disclosed in Applicants' specification, European Patent 0725440 (*Loboda* U.S. Pat. No. 5,818,071), is designed to accommodate a subtractive deposition in which the substrate deposition ↗ deposits the metal layer, then etches the metal and deposits the SiC into the etched metal layer. Therefore, routine optimization of the silicon carbide barrier layer of European Patent 0725440 in view of the other references as asserted by the Examiner would not suggest or motivate depositing a silicon carbide etch stop or a silicon carbide anti-reflective coating as recited in one or more of the rejected claims. European Patent

0725440 further provides no disclosure or suggestion of depositing a first dielectric layer *in situ* on a silicon carbide layer or depositing a photoresist layer.

Further, *Wang et al.* and Applicants disclosure of knowledge does not teach, show, or suggest depositing silicon carbide materials, either *in situ*, or with other dielectric materials, or depositing silicon carbide materials as barrier layers, etch stops, or as ARC films.

Endo et al., European Patent 0725440, *Wang et al.*, and Applicants disclosure of knowledge, either alone or in combination, do not teach, show or suggest depositing a silicon carbide layer, depositing a first dielectric layer *in situ* on the silicon carbide layer, and then depositing a photoresist layer as recited in claim 14. *Endo et al.*, European Patent 0725440, *Wang et al.*, and Applicants disclosure of knowledge, either alone or in combination, do not teach, show or suggest depositing a silicon carbide barrier layer on the substrate, depositing a first dielectric layer *in situ* on the barrier layer, depositing an etch stop *in situ* on the first dielectric layer, depositing a second dielectric layer *in situ* on the etch stop, depositing a silicon carbide anti-reflective coating *in situ* on the second dielectric layer and depositing a photoresist layer on the silicon carbide anti-reflective coating as recited in claim 26.

Therefore, *Endo et al.*, European Patent 0725440, *Wang et al.*, and Applicants disclosure of knowledge, either alone or in combination, do not teach, show or suggest claimed aspects of the invention.

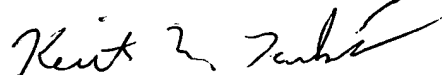
The Examiner takes Official Notice that the structure of claim 31 was known prior to Applicant's invention. Applicant traverses the Examiner's Official Notice with regard to claim 31 as improper on grounds that the official notice is directed to layer arrangements and does not address the claimed methods of depositing the layers. Applicants believe that the claims are definite and non-obvious over the prior art and respectfully request that Examiner provide support for the assertion of the Examiner's Official Notice regarding the pending claims.

The prior art made of record is noted. However, it is believed that the secondary references are no more pertinent to the Applicants' disclosure than the primary references cited in the office action. Therefore, it is believed that a detailed discussion

of the secondary references is not deemed necessary for a full and complete response to this office action. Accordingly, allowance of the claims is respectfully requested.

In conclusion, the references cited by the Examiner, neither alone nor in combination, teach, show, or suggest the claimed aspects of the invention. Having addressed all issues set out in the office action, applicants respectfully submit that the claims are in condition for allowance and respectfully request that the claims be allowed.

Respectfully submitted,



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